

## C8- Rates of Reaction Practice Paper 1

Name:

Score:

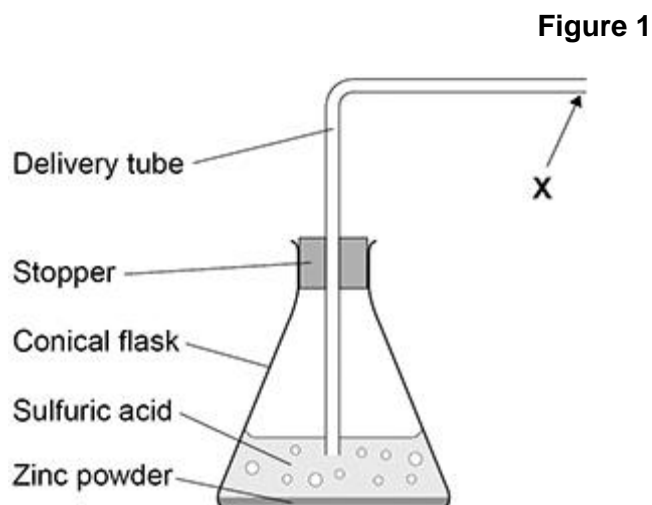
Q1.

A student investigated the rate of the reaction between zinc and sulfuric acid.

This is the method used.

1. Pour 40 cm<sup>3</sup> of sulfuric acid into a conical flask.
2. Add 2.0 g of zinc powder to the conical flask.
3. Put the stopper in the conical flask.
4. Measure the volume of hydrogen gas collected every 30 seconds for 5 minutes.

**Figure 1** shows part of the apparatus used.



- (a) **X** shows where a piece of equipment is connected to measure the volume of hydrogen gas collected.

Complete **Figure 1** to show the equipment used.

(1)

- (b) The student made an error setting up the delivery tube shown in **Figure 1**.

Describe the error **and** the problem this error would cause.

Error made \_\_\_\_\_  
\_\_\_\_\_

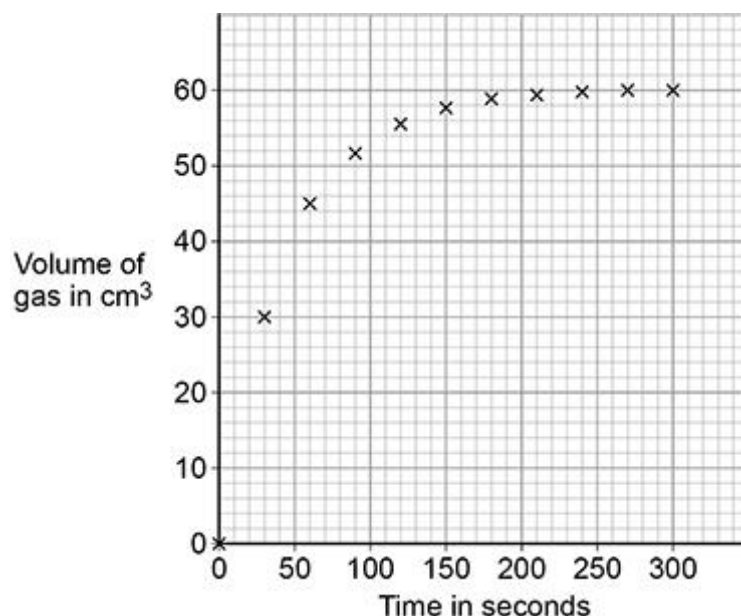
Problem caused \_\_\_\_\_  
\_\_\_\_\_

(2)

The student then set up the apparatus correctly.

**Figure 2** shows the student's results.

**Figure 2**



(c) Complete **Figure 2** by drawing a line of best fit.

(1)

(d) Determine the mean rate of reaction between 0 seconds and 60 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas formed}}{\text{time taken}}$$

Use data from **Figure 2**.

Give the unit.

Choose the answer from the box.

<b>cm<sup>3</sup> / s</b>	<b>g / s</b>	<b>s / cm<sup>3</sup></b>	<b>s / g</b>
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Mean rate of reaction = \_\_\_\_\_ Unit \_\_\_\_\_

(4)

(e) The student repeated the investigation using sulfuric acid of a higher concentration.

The student plotted the results and drew a line of best fit.

How would the line of best fit for higher concentration compare with the line of best fit for lower concentration?

Tick (✓) **one** box.

The line of best fit for higher concentration would have a less steep

slope.

The line of best fit for higher concentration would have a steeper slope.

The lines of best fit would have slopes with the same steepness.

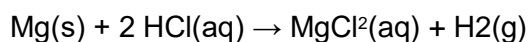
(1)  
(Total 9 marks)

## Q2.

This question is about rate of reaction.

A student investigated the rate of the reaction between magnesium and dilute hydrochloric acid.

The equation for the reaction is:



- (a) Which state symbol in the equation for the reaction does not represent one of the three states of matter?

\_\_\_\_\_

(1)

The student determined the rate of production of hydrogen gas.

- (b) What **two** pieces of measuring apparatus could the student use to find the rate of production of hydrogen gas?

1 \_\_\_\_\_

2 \_\_\_\_\_

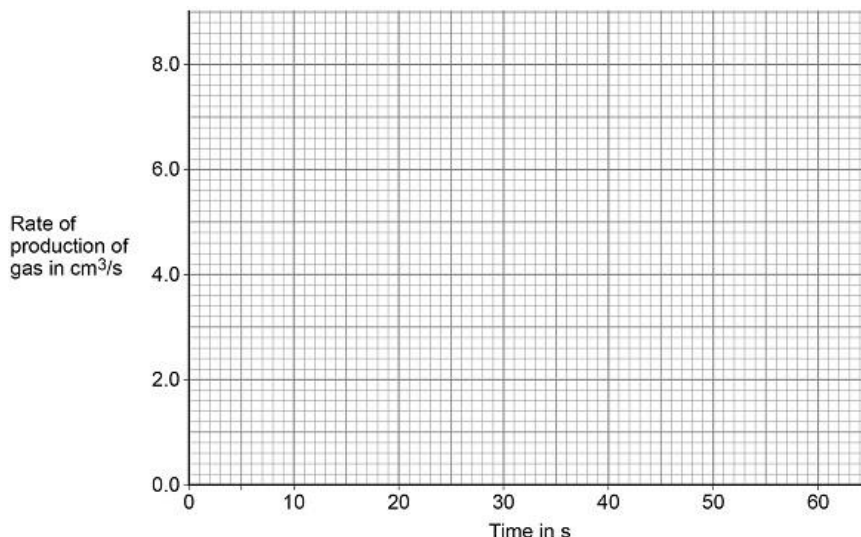
(2)

The following table shows the results of the investigation.

Time in s	Rate of production of gas in cm <sup>3</sup> /s
10	6.9
20	3.9
30	2.0
40	0.9
50	0.3
60	0.0

(c) Plot the data from the table on the graph below.

You should draw a line of best fit.



(3)

(d) Give **three** conclusions that can be drawn about the rate of reaction between magnesium and dilute hydrochloric acid in this investigation.

Use data from the graph and the table above.

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_

(3)

(e) The student repeated the investigation using dilute hydrochloric acid at a higher temperature.

All the other variables were kept the same.

Which **two** statements are correct?

Tick (✓) **two** boxes.

More bubbles were produced in the first 10 seconds.

The activation energy for the reaction was higher.

The magnesium was used up more quickly.

The reaction finished at the same time.

The total volume of gas collected was greater.

(2)(Total 11 marks)

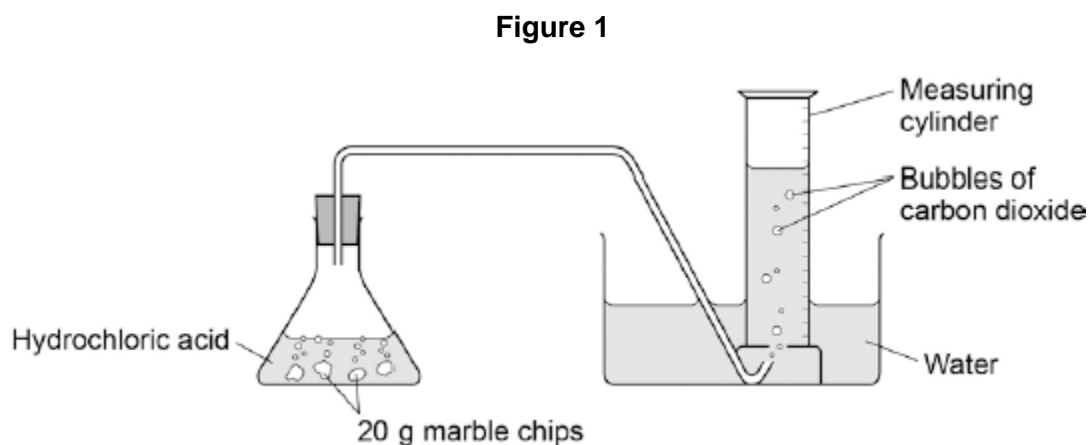
## Higher Tier Questions:

### Q3.

Marble chips are mainly calcium carbonate ( $\text{CaCO}_3$ ).

A student investigated the rate of reaction between marble chips and hydrochloric acid (HCl).

**Figure 1** shows the apparatus the student used.



- (a) Complete and balance the equation for the reaction between marble chips and hydrochloric acid.



(2)

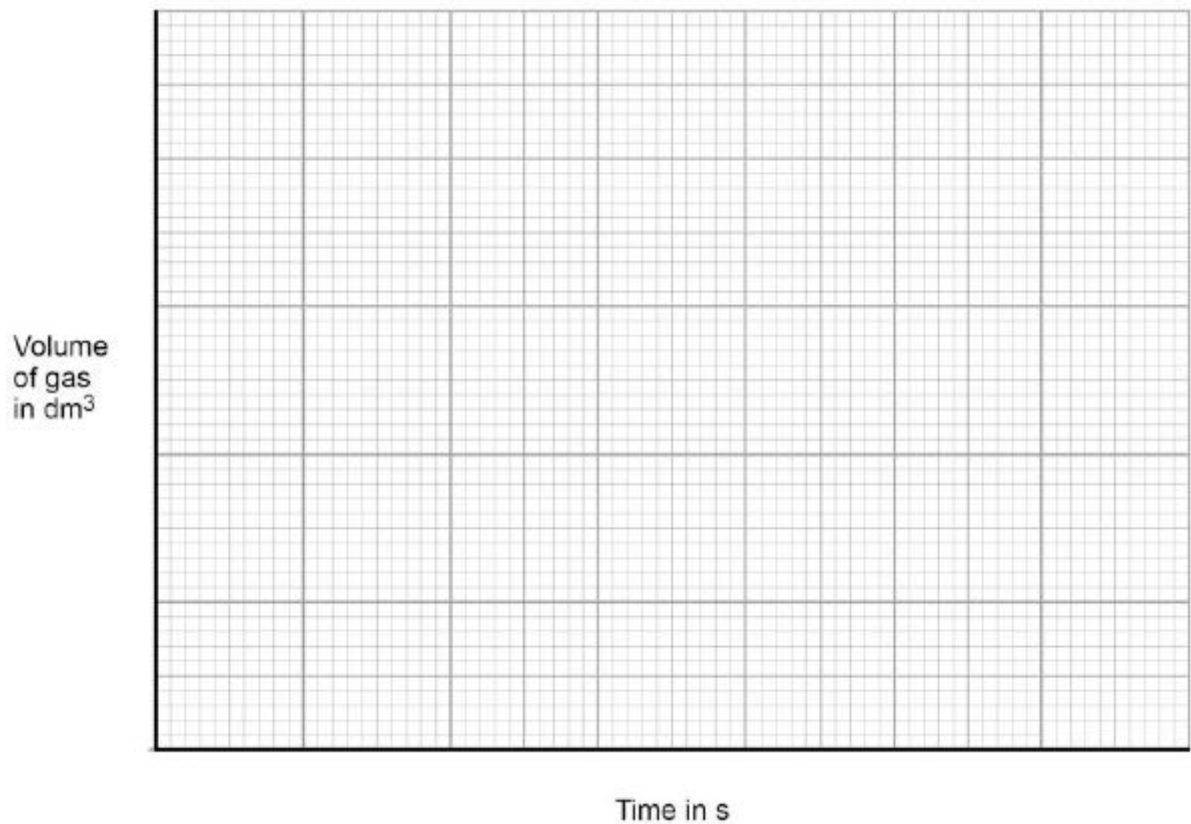
- (b) The table below shows the student's results.

Time in s	Volume of gas in $\text{dm}^3$
0	0.000
30	0.030
60	0.046
90	0.052
120	0.065
150	0.070
180	0.076
210	0.079
240	0.080
270	0.080

On **Figure 2**:

- Plot these results on the grid.
- Draw a line of best fit.

**Figure 2**



(4)

- (c) Sketch a line on the grid in **Figure 2** to show the results you would expect if the experiment was repeated using 20 g of smaller marble chips.

Label this line **A**.

(2)

- (d) Explain, in terms of particles, how and why the rate of reaction changes during the reaction of calcium carbonate with hydrochloric acid.

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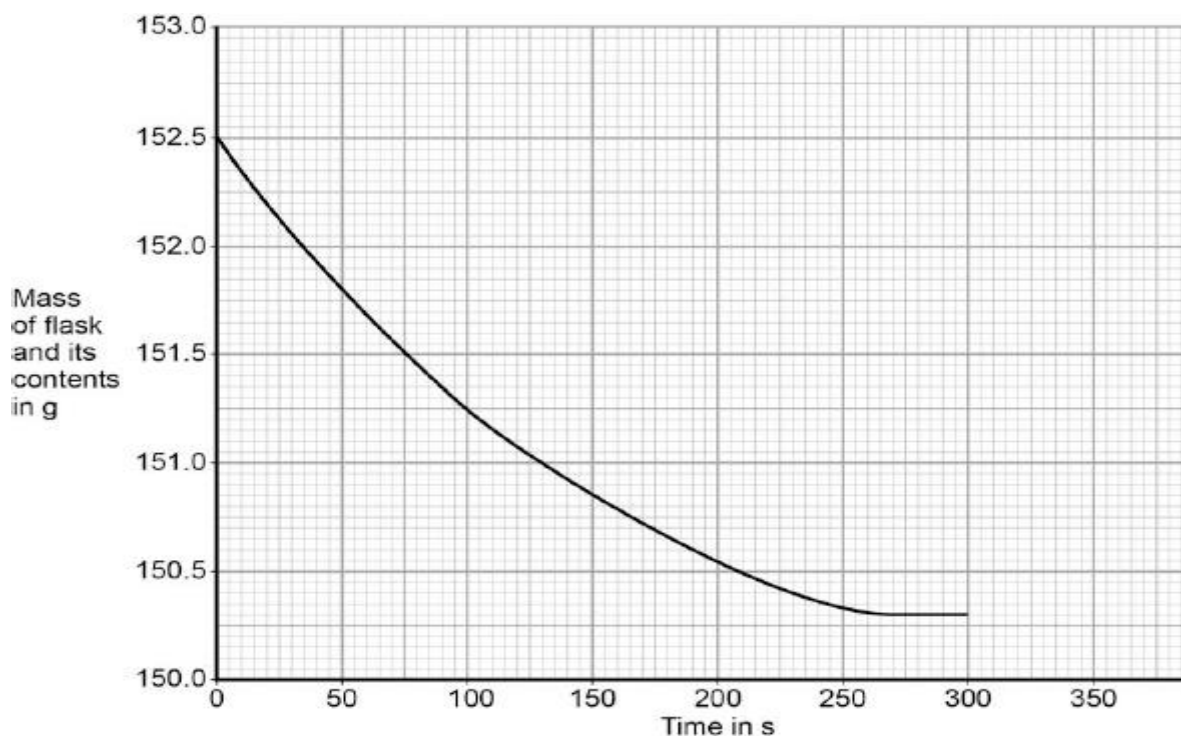
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(4)

(e) Another student investigated the rate of reaction by measuring the change in mass.

**Figure 3** shows the graph plotted from this student's results.

**Figure 3**



Use **Figure 3** to calculate the mean rate of the reaction up to the time the reaction is complete.

Give your answer to three significant figures.

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Mean rate of reaction = \_\_\_\_\_ g / s

(4)

(f) Use **Figure 3** to determine the rate of reaction at 150 seconds.

Show your working on **Figure 3**.

Give your answer in standard form.

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Rate of reaction at 150 s = \_\_\_\_\_ g / s

(4)(Total 20 marks)

## Mark schemes

### Q1.

(a) (diagram)  
gas syringe  
**or**  
inverted measuring cylinder over water

1

(b) (error)  
(delivery) tube is in (sulfuric) acid

1

(problem)  
(sulfuric) acid will travel up tube  
**or**  
no hydrogen / gas will be collected

1

(c) line of best fit  
*must include 0, 0*

1

(d) (volume of gas =) 45 (cm<sup>3</sup>)  
*allow a tolerance of  $\pm \frac{1}{2}$  a small square*  
*allow volume from drawn curve*

1

(rate =)  $\frac{45}{60}$   
*allow correct use of incorrectly determined volume at 60 seconds*

1

= 0.75

1

cm<sup>3</sup>/s

1

(e) the line of best fit for higher concentration would have a steeper slope

1

[9]

### Q2.

(a) (aq)  
*allow aqueous / aq*

1

(b) (gas) syringe  
*allow measuring cylinder (and water trough)*  
*allow balance*

1

stopclock / stopwatch



	<i>allow timer / clock / watch</i>	1
(c)	all points plotted correctly <i>allow a tolerance of <math>\pm \frac{1}{2}</math> a small square</i> <i>allow at least 3 points plotted correctly for 1 mark.</i>	2
	line of best fit <i>allow correctly drawn line of best fit for incorrectly plotted points</i>	1
(d)	(rate) decreases <i>allow slows down</i>	1
	(rate decreases) more slowly as time increases <i>allow (rate decreases) at a non-linear rate</i>	1
	(rate) becomes zero at 60 s <i>allow the reaction stops at 60 s</i> <i>allow ecf from part (c)</i>	1
(e)	more bubbles were produced in the first 10 seconds	1
	the magnesium was used up more quickly	1
		[11]

### Higher Tier Mark Scheme

#### Q3.

(a)	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ <i>allow 1 mark for correct formulae</i>	2
(b)	sensible scales, using at least half the grid for the points  all points correct <i><math>\pm \frac{1}{2}</math> small square</i> <i>allow 1 mark if 8 or 9 of the points are correct</i>	2
	best fit line	1
(c)	steeper line to left of original	1
	line finishes at same overall volume of gas collected	

- (d) acid particles used up 1  
*allow marble / reactant used up* 1
- so concentration decreases 1  
*allow surface area of marble decreases* 1
- so less frequent collisions / fewer collisions per second 1  
*do **not** accept fewer collisions unqualified* 1
- so rate decreases / reaction slows down 1
- (e) mass lost of 2.2 (g) 1
- time taken of 1  
 270 s  
*allow values in range 265 – 270* 1
- $\frac{2.2}{270} = 0.00814814$   
*allow ecf for values given for mass and time* 1
- 0.00815 (g / s)
- or**
- $8.15 \times 10^{-3}$   
*allow 1 mark for correct calculation of value to 3 sig figs*  
*accept 0.00815 or  $8.15 \times 10^{-3}$  with no working shown for 4 marks* 1
- (f) correct tangent 1
- eg 0.35 / 50 1
- 0.007 1  
*allow values in range of 0.0065 – 0.0075* 1
- $7 \times 10^{-3}$  1  
*accept  $7 \times 10^{-3}$  with no working shown for 4 marks*